Chemical and Physical Biology

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The Chemical and Physical Biology (CPB) concentration provides students with a broad foundation in the physical and life sciences. This concentration is designed for students interested in applying quantitative tools, physical concepts, and chemical principles to the study of biology.

Remarkable progress in the last four decades has revealed the atomic structure of proteins, enzymes, and genes, the nature of the genetic code, and how genes can be turned on or off in response to the demands of the environment. As our understanding of fundamental biological processes has increased, so has our appreciation that the focus on information transfer through nucleic acids provides an inadequate basis for understanding living systems. The activities of proteins are regulated by post-translational modifications – chemical changes in protein structure – and are affected by small signaling molecules. Dissecting metabolic pathways and reconstructing cellular networks requires supplementing the traditional arsenal of molecular, genetic, biochemical, and cell biological techniques with advances in chemical and physical methods that make it possible to characterize the state of a biological system under a given set of conditions. Chemical and physical biology provides a link between classical approaches to studying biology and the chemical tools and physical methods required to understand dynamic changes in complex biological systems.

Students who are interested in understanding living systems in detail will require considerable proficiency in mathematics and physics as well as a broad background in both chemistry and biology. In its emphasis on quantitative, physical, and chemical tools, this concentration represents a significant departure from traditional biochemistry and molecular biology concentrations. Our goal is to provide the next generation of life scientists with the background needed to make new advances in the quantitative understanding of living systems.

All students are required to participate in a tutorial unless engaged in thesis research. Tutorials for students in both Chemical and Physical Biology and Molecular and Cellular Biology are offered by the Board of Tutors in Biochemical Sciences, which was established in 1926. Each tutor holds a PhD and/or an MD degree and meets with her or his students, singly or in small groups, about twice a month to discuss topics tailored largely to individual interests and needs. Tutorial sessions typically consist of readings selected from the primary literature or relevant texts.

All students are required to obtain a minimum of one term of laboratory research experience. This requirement may be fulfilled through a project lab course, a term of laboratory research (Chemical and Physical Biology 91r), or research for a senior thesis (Chemical and Physical Biology 99).

A thesis based on laboratory research is required to be eligible for honors in the Chemical and Physical Biology concentration. Students are encouraged to begin thesis research in a laboratory no later than the start of their junior year.

REQUIREMENTS:
Basic Requirements: 15 half-courses

1. *Required courses:*
   a. *Life Sciences:* Life Sciences 1a and Life Sciences 1b, or equivalent.
   b. *Molecular and Cellular Biology:* Molecular and Cellular Biology 52 and 54 (Formerly Biological Sciences 52 and 54).
   c. *Chemistry:* Physical Sciences 1 or Chemistry 160, or a suitable advanced course.
   d. *Organic Chemistry:* Chemistry 20 and 30, or Chemistry 17 and 27, or equivalent.
   e. *Physical Chemistry:* Molecular and Cellular Biology 199 or Chemistry 60 or 161.
   f. *Mathematics:* Mathematics 19a and 19b, or 21a and 21b, or Applied Mathematics 21a and 21b.
   g. *Physics:* Physics 11a and 11b or 15a (or 16) and 15b, or equivalent.
   h. Three upper-level courses in the natural sciences, engineering, and/or mathematics. Courses that meet this requirement include any 100-level chemistry, molecular and cellular biology, or physics course. Other courses that meet this requirement include: Computer Science 50; Engineering Science 123, 130, 145, 156; Applied Mathematics 105a, 105b, 106, 115, 147; Mathematics 106, 121; Systems Biology 200; Statistics 102, 110, 115. Students who do not write a thesis based on laboratory research (see item 3 under **Requirements for Honors Eligibility**) must take one upper level project lab course or enroll in one term of Chemical and Physical Biology 91r.
2. *Tutorial:* Required of all concentrators in sophomore and junior years unless engaged in thesis research. Tutorial sessions are non-credit, take place approximately twice per month, and typically consist of readings selected from the primary literature or relevant texts.

Requirements for Honors Eligibility: 16 half-courses

1. *Required Courses:* Same as **Basic Requirements**.
2. *Tutorial:* Same as **Basic Requirements**.
3. *Thesis:* A thesis based on independent laboratory research is required for honors eligibility. Students should therefore enroll in two terms of Chemical and Physical Biology 99, one of which counts towards the upper-level course requirement (see item 1h, above).

ADVISING

The Co-Head Tutors, Professors Erin O'Shea and Dan Kahne, serve as the advisers to students in Chemical and Physical Biology. The Board of Tutors in Biochemical Sciences runs the tutorial for CPB concentrators, which offers individualized instruction to all concentrators beginning after declaration. Mentoring on career choices, the research experience, and other academic issues is a logical extension of the tutorial. The Co-Head Tutors make all tutorial assignments and are available throughout the academic year to answer questions from students or their tutors.

For up-to-date information on advising in Chemical and Physical Biology, please see the Advising Programs Office website: *www.fas.harvard.edu/~advising/concentrations/Chemical-PhysBio.html*.

RESOURCES

A Tutorial Reference Library is housed in the Student Affairs Office at 7 Divinity Avenue, and contains books and journals frequently used for tutorial reading.

HOW TO FIND OUT MORE

Co-Head Tutors of Chemical and Physical Biology: Professor Erin O'Shea, Bauer 307, 7 Divinity Avenue, 617-495-4328, *erin_oshea@harvard.edu*; and Professor Daniel Kahne, Naito 104; 617-496-0208, *kahne@chemistry.harvard.edu*. The Student Affairs Office for Chemical and Physical Biology is located in Sherman Fairchild Room 195, 7 Divinity Avenue (617-495-4106). Lists of members of the Board of Tutors in Biochemical Sciences and of the Committee on Chemical and Physical Biology and descriptions of their research interests are available in the Student Affairs Office. For more information about the CPB concentration, visit *www.lifescience.fas.harvard.edu* and click on the link for Chemical and Physical Biology under the "concentrations" tab.

ENROLLMENT STATISTICS

Number of concentrators as of November

Concentrators	2006
Chemical and Physical Biology	27
CPB + another field	2
Another field + CPB	0